Protocol Development Summary

NETN Protocol: Wetland Condition

NETN parks where protocol will be implemented:
Acadia NP (ACAD), Marsh-Billings-Rockefeller NHP (MABI), Minute Man NHP (MIMA), Morristown NHP (MORR), Roosevelt-Vanderbilt NHS (ROVA), Saint-Gaudens NHS (SAGA), Saratoga NHP (SARA), Weir Farm NHS (WEFA)

Justification and issues being addressed:

Wetlands are important sites of biodiversity, and half of all endangered species are found in marshes, swamps, bogs and fens (Niering 1988). Wetlands serve many important ecological functions, including groundwater recharge, habitat for flora and fauna, soil erosion control, chemical uptake and transformation, and flood water control (Carter 1996, Mitsch and Gosselink 1993). Wetlands of the NETN are threatened by a suite of anthropogenic stresses associated with increasing visitor pressure and rapid residential development of watersheds adjacent to the parks. A monitoring program is essential to help resource managers document trends in wetland condition, evaluate potential threats, and identify areas of management concern. This protocol will identify robust indicators of wetland function that are suitable for monitoring the condition of the NETN predominant wetland types (freshwater emergent wetlands, forested and scrub/shrub wetlands, peatlands, and salt marshes), and determine the sample size necessary to detect change in these variables through routine monitoring. The protocol will also identify landscape attributes that can be used to assess the susceptibility of park wetlands to anthropogenic stressors as a basis for a stratified sampling design.

Specific monitoring questions and objectives addressed by the protocol:

1) Determine the status, trends, and natural variability of species richness, abundance, and diversity of wetland plant communities in selected NETN wetland types.

Justification/Rationale for this Objective: Wetlands are in part defined by the plants growing in them (Cowardin et al. 1979), and repeated, non-destructive measurements of the same sites are the optimal means of describing community change over time. No single estimator captures all community properties, and variables such as species richness and Shannon's index (a measure of the equitability of species distribution) provide simple but useful guides to community properties (McCune and Grace 2002). Finally, the relative abundance of invasive species and other function and legal groups provides a useful and easily calculated set of indicators to managers, allowing them to assess the results of management actions and the present and future needs of the park. This is especially true as more data are collected, and indicator trends can be analyzed. A primary goal of this objective is to describe wetland plant communities within NETN parks in terms of plant species richness, species abundance (based on cover measurements), diversity indices, and by plant functional group (i.e., woody, herbaceous, clonal, etc) and status (invasive, exotic, native, sensitive, etc). Additionally, community composition variation will be described, both in space (within and among wetlands) and

through time. Finally, indicators such as the relative abundance of invasive species per site will be calculated.

2) Determine the status and trends in wetland habitat indicators such as nutrient regimes, water level, temperature, water chemistry, hydrological fluctuations, and isolated disturbances in hydrology.

> ***Justification/Rationale for this Objective***: Wetland types, from wet meadows to swamps, are determined in large part by site hydrology (Cowardin et al. 1979, Keddy 2000), and high nutrient levels can facilitate the growth of invasive species (Keddy, 2000). Our approach envisions three tiers of increasingly complex and intensive measurements, the details of which are given in the Basic Approach section following. Changes in water level define the hydrology of the site, and multiple wells allow for estimates of within-site variation. Nitrogen and phosphorus are essential plant nutrients that have been shown in a wide variety of contexts to be determinants of plant growth (e.g., Lambers et al. 1998).

3) Determine status and trends in indicators of the relative abundance of invasive species in wetland communities of NETN parks.

> ***Justification/Rationale for this Objective***: In this objective, the relationships between plants and their environment will be analyzed with respect to temporal and spatial variability. Therefore, this objective also may allow insight into the factors favoring invasion exotic species into these wetlands.

Basic approach:

Two basic assumptions are made in this protocol. First, a long-term, homogenous data set is assumed to be essential in monitoring NETN wetlands. Ideally, that data set should be a continuous record, but practically, breaks in monitoring are less problematic than changes in protocol that make comparisons through time more difficult. The second assumption is that managers should show some flexibility to accommodate changing conditions. The protocol described here has three tiers, each adding additional measures and sampling intensity to the one below it. Data are comparable among tiers. Rather than specify an "all-or-nothing" protocol, the different tiers will allow managers to accommodate changing funding levels and management priorities. The methods described below have been used to meet similar monitoring goals in the Heartland Network. NETN will evaluate these methods and modify them to better meet our needs.

For all tiers, wetlands of a variety of sizes, from a few hundred square meters to several hectares, will be sampled. The wetlands will comprise the following general Cowardin (1979) types: emergent, scrub-shrub, and swamp. They will also occur under a variety of landscape contexts, from wetlands growing near agricultural or urban areas to ones that are part of largely forested watersheds. The number of wetlands will be decided in consultation with NETN park resource managers. Our priorities are 1) wetlands containing a large number of native species, and 2)

wetlands where intensive invasive species management is underway, to assess management activities.

All sites will be located randomly in wetlands. For the minimum protocol, three wells (slotted pipes) will be sunk in an east-west line, spaced 10 m apart. Four transects will be established on the center pipe, extending 25 meters north, south, east, and west. On each transect, a point vegetation sample will be taken at every meter (a tally of all species touching a sampling rod), plus height per species. The trunks of all trees within 2 meters of each transect will have diameter at breast height measured. In cases where the wetland is less than 50 meters across, transects will be used to record the edge of the wetland, to track fluctuation in wetland size over time. In each well, water levels, conductivity and pH will be measured. All measurements will be done at one time, once per year. The sensitivity of conductivity and pH measurements will be determined by the instruments used. Since instrumentation is expected to improve over time, rather than providing a specification, the sensitivity of instruments and tests used in monitoring database should be documented, along with the results from all sampling.

The medium tier incorporates all of the minimum samples. In this tier, four water samples (every two months, except in winter) and two vegetation samples (June and August) will be taken. Additionally, four 1-m^2 permanent quadrats will be established between the four transects, two meters from each transect. Within each quadrat, all vascular plant species will be recorded, and percent cover will be visually estimated. Percent cover and point tallies are not easily interconverted, and this sampling protocol not only allows both to be sampled, it samples wetland vegetation at two different scales. In addition to conductivity and pH, NO_3, NH_4, and P_i will measured in the water.

The maximum tier increases water sampling to every two months year-round, and vegetation will be sampled for bryophytes as well as vascular plants. Two more wells will be added to the array (10 m north and south of the central well), and four piezometers (25 m from the central well in a square) will be added to the water sampling array, so that direction of water flow can be measured. Total N and total P will also be measured in water samples, along with conductivity, pH, NO_3, NH_4, and P_i. Finally, soil chemistry (pH, NO_3, NH_4, and P_i) will be measured from four cores taken in random locations within the quadrats.

Data generated from this protocol will be stored in a Microsoft Access database, along with digital images recorded at each sampling, data on the tests used and the sensitivity of each technique, landscape data from existing GIS layers, and data from the invasive species management program. Data will be analyzed in appropriate statistical software.

Principal investigators and NPS lead:
Protocol development will be done through an interagency agreement with the USGS. The Principal Investigators will be Hilary Neckles and Glenn Guntenspergen, USGS Patuxent Wildlife Research Center. NPS lead: Brian Mitchell at NETN.

Development schedule, budget, and expected interim products:
The protocol will be developed summer 2006 through spring 2007. A draft protocol with SOPs will be developed by spring 2007, and protocol evaluation will occur in summer 2007.

The anticipated budget for FY2006 is $83,000.

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